O-2011
OPERATE THE VOR AND DME

CONDITIONS

You are an Observer trainee and must use the VOR and DME for navigation and position determination.

OBJECTIVES

Demonstrate how to use the VOR and DME for navigation and position determination.

TRAINING AND EVALUATION

Training Outline

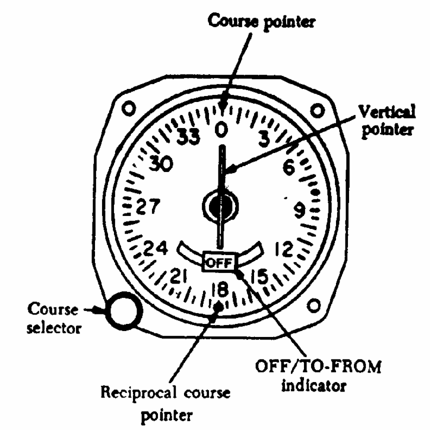
1. As a Mission Observer trainee, knowing how to use navaids and their limitations is essential for situational awareness. The Very High Frequency Omnidirectional Range (VOR) radio navigation system and Distance Measuring Equipment (DME) allows the aircraft to be flown to a desired location, such as a search pattern entry point, with precision and economy. Once in the search or assessment area, these navaids allow the pilot to fly the assigned area fairly accurately. From the mission staff's viewpoint, proper use of these navaids assures them that the assigned area was actually flown -- the only variables left to accommodate are search effectiveness and the inherent limitations of scanning.

One drawback is that setting up and manipulating the VORs and DME may distract the pilot (and observer) from looking outside of the aircraft. The great majority of CAP missions are performed in VFR conditions, and the CAP aircrew must not forget the importance of looking where you're going. The best way to avoid this trap is to become and continue to be very familiar with the operation of the GPS. Training and practice (along with checklists or aids) allows each crewmember to set or adjust instruments with minimum fuss and bother, thus allowing them to return their gaze outside the aircraft where it belongs. All members of the aircrew should be continuously aware of this trap.

Additionally, it is important that observers use this equipment to help the pilot maintain situational awareness. *The observer should always know the aircraft's position on the sectional chart*, and the VOR/DME enables him or her to do so with good accuracy.

2. *ADF*. The Automatic Direction Finder is used to receive radio guidance from stations such as four-course ranges, radio beacons, and commercial broadcast facilities. The automatic direction finder indicates the direction of the station being received shown in relation to the heading of the aircraft: thus, the ADF can be helpful in maintaining situational awareness. The ADF is the least accurate of all the navigational instruments.

3. *VOR*. The Very High Frequency Omnidirectional Range (VOR) radio navigation system transmits 360 directional radio beams or *radials* that, if visible, would resemble the spokes radiating from the hub of a bicycle wheel. Each station is aligned to magnetic north so that the 000 radial points from the station to magnetic north. Every other radial is identified by the magnetic direction to which it points *from* the station, allowing the pilot to navigate directly to or from the station by tracking along the proper radial. The VOR is an accurate and reliable navigational system, and is the current basis for all instrument flight in the U.S. To help light plane pilots plan and chose routings, the FAA has developed the Victor airway system, a “highway” system in the sky that uses specific courses to and from selected VORs. When tracing the route of a missing aircraft, search airplanes may initially fly the same route as the missing plane, so it is very important you know the proper procedures for tracking VOR radials.



The figure above shows a VOR indicator and the components that give the information needed to navigate, including a vertical pointer, OFF/TO-FROM flag or window, and a course-select knob. The vertical pointer, also called a course deviation indicator (CDI), is a vertically mounted needle that swings left or right showing the airplane's location in relation to the course selected beneath the course pointer. The OFF/TO-FROM indicator shows whether the course selected will take the airplane to or from the station. When it shows "OFF", the receiver is either not turned on or it's not receiving signals on the selected frequency. The course selector knob is used to select the desired course to fly either toward or away from the station.

Flying to the VOR station is simple. Find the station's frequency and its Morse code audio identifier using the sectional chart. Next, tune the receiver to the correct frequency and identify the station by listening to its Morse code (if you can't positively identify the station, you should not use it for navigation). After identifying the station, slowly turn the course selector knob until the TO-FROM indicator shows TO and the CDI needle is centered. If you look at the course that's selected beneath the course pointer at the top of the indicator, you'll see the course that will take you directly to the station. The pilot turns the aircraft to match the airplane's heading with that course and corrects for any known winds by adding or subtracting a drift correction factor. The pilot keeps the CDI centered by using very small heading corrections and flies the aircraft directly to the station. When the aircraft passes over the station, the TO-FROM indicator will flip from TO to FROM.

To fly away from a station, tune and identify the VOR, then slowly rotate the course select knob until the CDI is centered with a FROM indication in the window. Look at the selected course, again normally at the top of the indicator, to determine the outbound course. The pilot turns the aircraft to that heading, corrects for wind drift, and keeps the CDI needle in the center to fly directly away from the station.

VORs can be used to determine a position in relation to a selected station. Rotate the course select knob slowly until the CDI is centered with a FROM indication, and look beneath the reciprocal course pointer for the radial. You can draw that radial as a line of position from the station's symbol on the sectional chart. Each VOR station on the chart has a surrounding compass ring already oriented towards magnetic north. Therefore, it isn't necessary to correct for magnetic variation. The use of the printed compass circle surrounding the station on the chart eliminates the need for using the plotter's protractor as well. Use any straight edge to draw the radial by connecting the station symbol with a pencil line through the appropriate radial along the circle. The radial drawn on the chart shows direction, but does not indicate distance from the station. But, you can get an accurate position "fix" by repeating the procedure with another VOR.

[Note: In order to use a VOR for instrument flight, the receiver must be functionally checked every thirty days (or prior to any instrument flight). This check must be performed by an instrument rated pilot and logged in the aircraft's flight logbook.]

4. *DME*. Finding bearing or direction to a station solves only one piece of the navigation puzzle: knowing the distance to the station is the final piece to the puzzle that allows fliers to navigate more precisely. You can use crossing position lines from two radio stations to obtain your distance from the stations, but an easier method is provided by Distance Measuring Equipment. DME continuously measures the distance of the aircraft from a DME ground unit that is usually co-located with the VOR transmitter (then called a VORTAC). The system consists of a ground-based receiver/transmitter combination called a transponder, and an airborne component called an interrogator. The interrogator emits a pulse or signal, which is received by the ground-based transponder. The transponder then transmits a reply signal to the interrogator. The aircraft's DME equipment measures the elapsed time between the transmission of the interrogator's signal and the reception of the transponder's reply and converts that time measurement into a distance. This measurement is the actual, straight-line distance from the ground unit to the aircraft, and is called *slant range*. This distance is continuously displayed, typically in miles and tenths of miles, on a dial or digital indicator on the instrument panel. When DME is used in combination with VOR, you can tell at a glance the direction and distance to a tuned station.

DME measures straight-line distance, or slant range, so *there is always an altitude component within the displayed distance*. If you fly toward a station at an altitude of 6,000 feet over the station elevation, the DME will never read zero. It will continuously decrease until it stops at one mile. That mile represents the aircraft's altitude above the station. The distance readout will then begin to increase on the other side of the station. Under most circumstances the altitude component of slant range can be ignored, but when reporting position using DME, especially to air traffic controllers, it is customary to report distances in "DME", not nautical miles, e.g., "Holly Springs 099° radial at 76 DME." [Some DME equipment can also compute and display the actual ground speed of the aircraft, provided that the aircraft is flying *directly* to or from the ground station. In all other circumstances, the ground speed information is not accurate and should be ignored.]

Additional Information

The GPS is covered in Task O-2012, and may be performed concurrently with this task. More detailed information on this topic and examples are available in Chapter 8 of the MART.

Evaluation Preparation

Setup: Provide the student access to an aircraft or simulator.

Brief Student: You are an Observer trainee asked to determine aircraft position with the VOR and DME.

Evaluation

Performance measures	Results
1. Use (or discuss) the ADF to determine approximate position.	P F
2. Determine aircraft position with the VOR, and discuss how to use the VOR to fly to/from a station. Also determine position by cross-radials.	P F
3. Determine aircraft position with the DME, and discuss the limitations of DME.	P F
4. Discuss the limitations of each navaid.	P F

Student must receive a pass on all performance measures to qualify in this task. If the individual fails any measure, show what was done wrong and how to do it correctly.